

UNIVERSIDADE DO VALE DO ITAJAÍ
ENGENHARIA DE COMPUTAÇÃO
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CIRCUITOS ELETRÔNICA BÁSICA – M1

Relatório apresentado como requisito parcial para a obtenção da M1 da disciplina de Eletrônica básica do curso de Engenharia de Computação pela Universidade do Vale do Itajaí da Escola do Mar, Ciência e Tecnologia.

Prof. Walter Antonio Gontijo

1. OBJETIVO

2. INTRODUÇÃO

3. CIRCUITOS

3.1 – REVISÃO DE ANÁLISE DE CIRCUITOS ELÉTRICOS

3.1.1- RESISTÊNCIA EQUIVALENTE

Encontre a resistência equivalente dos circuitos abaixo:

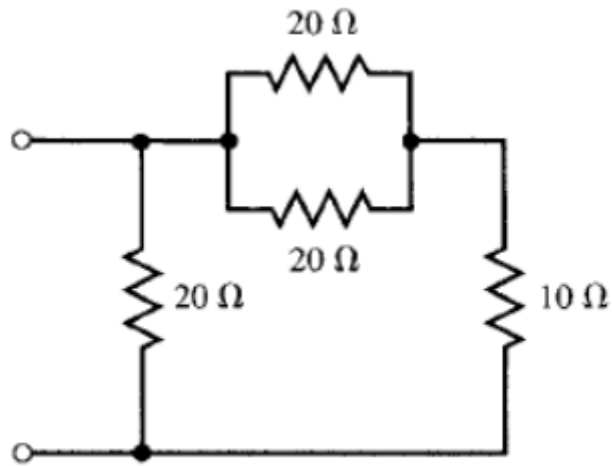


Figura 1 - Circuito 3.1.1 proposto

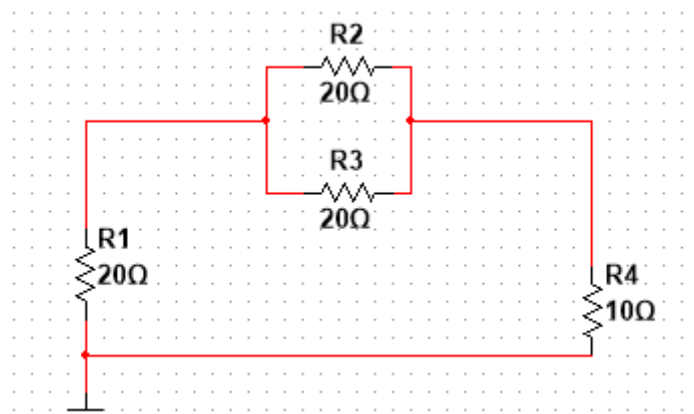


Figura 2 - Circuito 3.1.1 simulado no Multisim

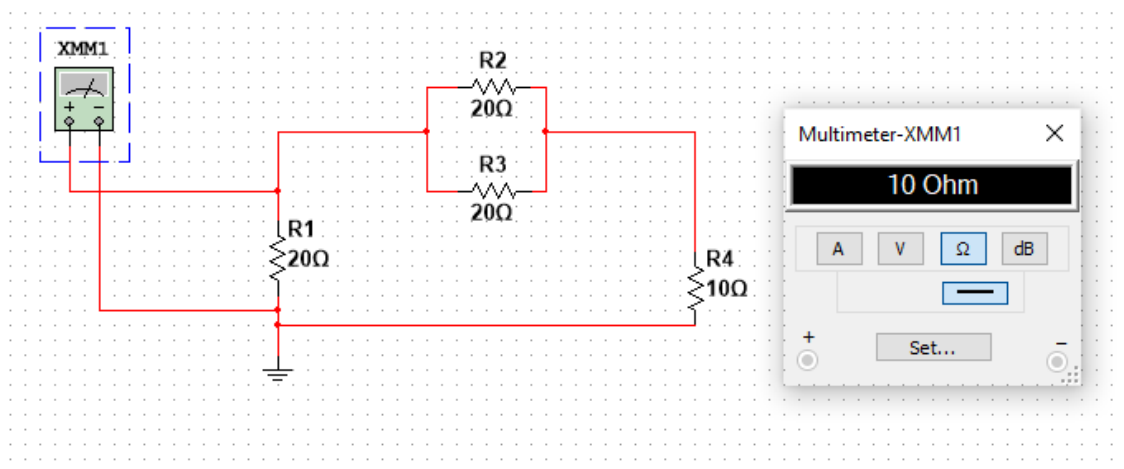


Figura 3 - Resistência equivalente do circuito 3.1.1 mensurada no Multisim

CÁLCULOS

$20\ \Omega \parallel 20\ \Omega + 10 = \frac{20 \cdot 20}{20 + 20} = \frac{400}{40} = 10\ \Omega$
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TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
Resistência equivalente	10 Ω	10 Ω

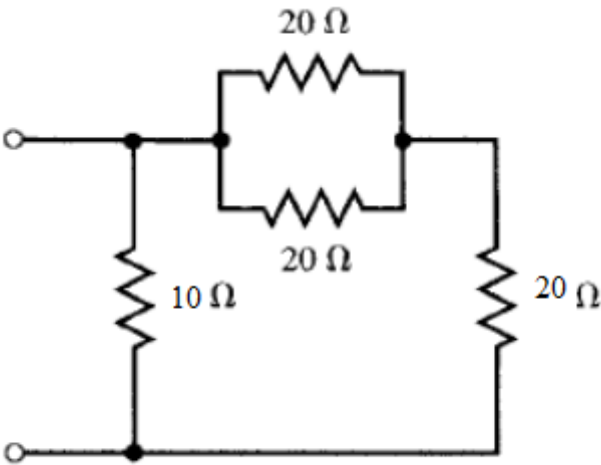


Figura 4 - Circuito 3.1.2 proposto

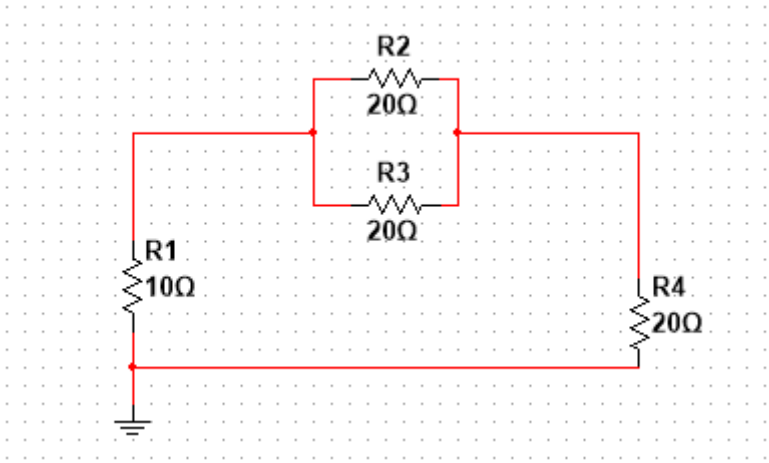


Figura 5 - Circuito 3.1.2 simulado

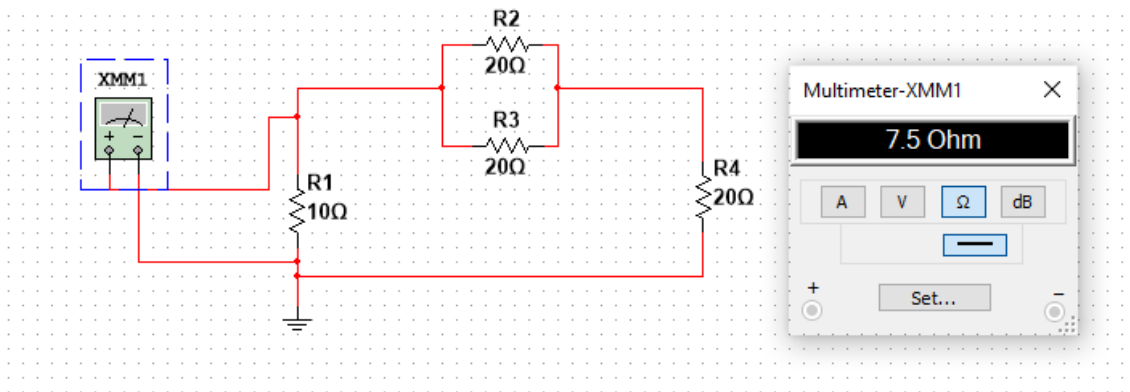


Figura 6 - Resistência equivalente do circuito 3.1.2 mensurada

CÁLCULOS

$$(20 \, \Omega \parallel 20 \, \Omega + 20 \, \Omega) = \frac{20 \cdot 20}{20 + 20} = \frac{400}{40} = 10 \, \Omega + 20 \, \Omega$$

$$30 \, \Omega \parallel 10 \, \Omega = 7,5 \, \Omega$$

TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
Resistência equivalente	7,5 Ω	7,5 Ω

3.1.3 - MALHA SIMPLES

Encontre V_3 e sua polaridade levando em conta que a corrente I no circuito é de 0,40 A.

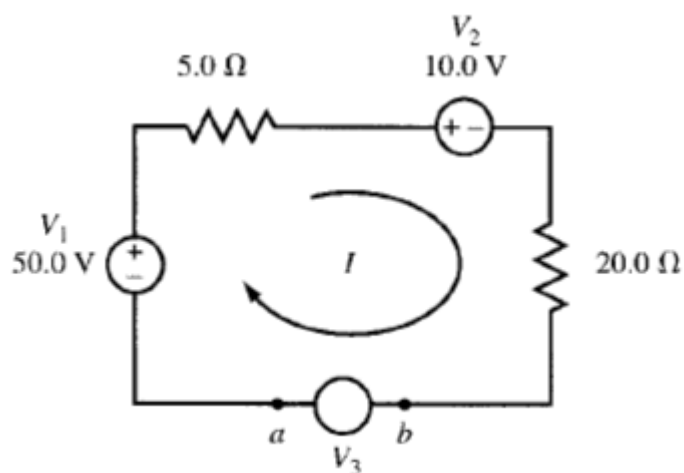


Figura 7 - Circuito 3.1.3 proposto

CÁLCULOS

$$R_{eq} = 20 \, \Omega + 5 \, \Omega = 25 \, \Omega$$

$$- 50V + 25i + 10 \, V = 0$$

$$- 40 \, V = -25 \, i$$

$$i = \frac{40}{25} = 1,6 \text{ A}$$

$$V = R * I$$

$$V_{ab} = 25 * 0,4 \text{ A}$$

$$V_{ab} = 10 \text{ V}$$

$$V_x = 25 * 1,6 \text{ A}$$

$$V_x = 40 \text{ V}$$

$$V_3 = V_x - V_{ab}$$

$$V_3 = 30 \text{ V}$$

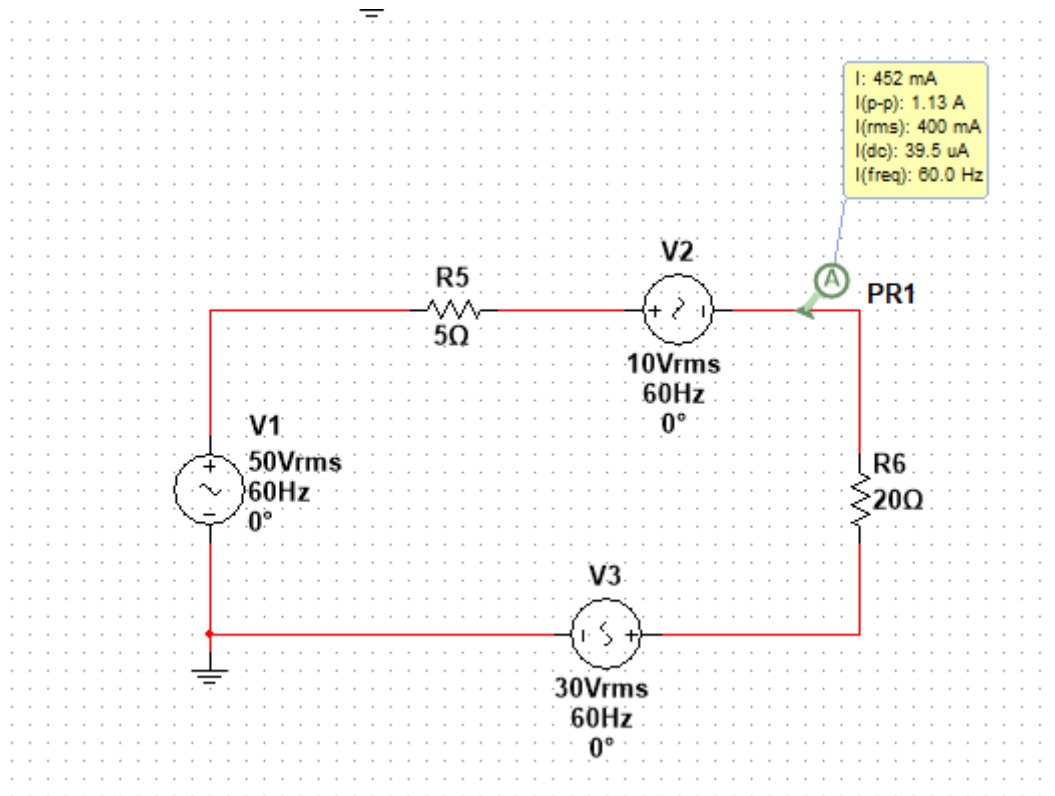


Figura 8 - Circuito 3.1.3 simulado

TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
Corrente no circuito	0,4 A	0,4 A
V3	30 V	30 V

3.1.14 – MALHAS

Encontre os valores de corrente no circuito a seguir:

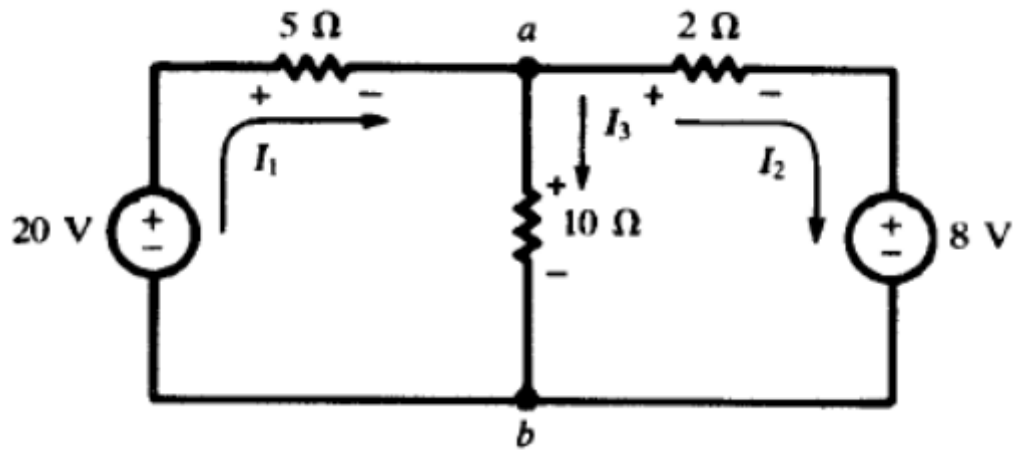


Figura 9 - Circuito 3.1.4 proposto

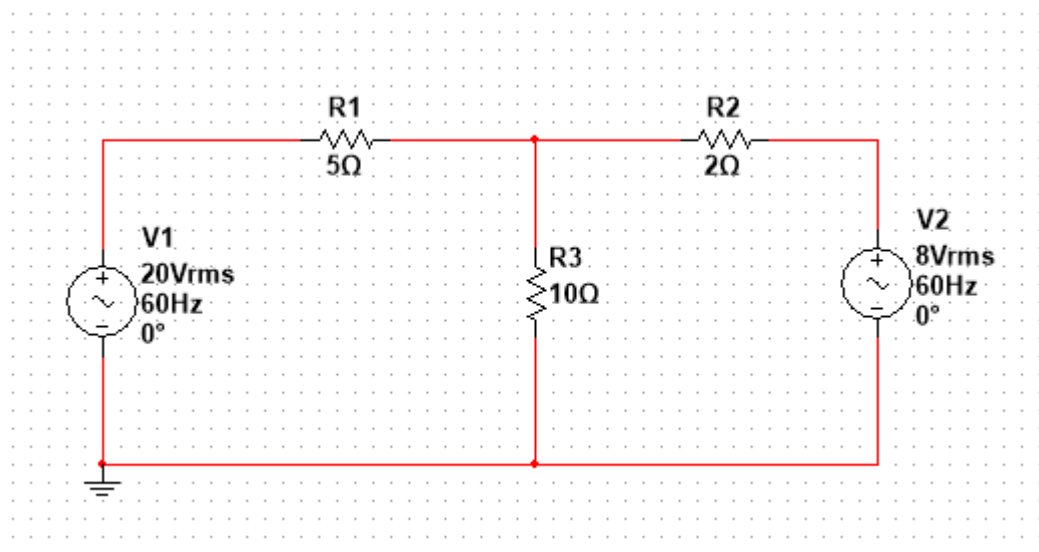


Figura 10 - Circuito 3.1.4 simulado

CÁLCULOS

Malha 1:

$$-20V + 5i_1 + 10(i_1 - i_2) = 0$$

$$5i_1 + 10i_1 - 10i_2 = 20$$

$$15i_1 - 10i_2 = 20$$

Malha 2:

$$8V - 10(i_1 - i_2) + 2i_2 = 0$$

$$-10i_1 + 10i_2 + 2i_2 = -8V$$

$$\begin{cases} 15i_1 - 10i_2 = 20 \quad (* 12) \\ -10i_1 + 10i_2 + 2i_2 = -8 \quad (* 10) \end{cases}$$

$$\begin{cases} 180i_1 - 120i_2 = 240 \\ -100i_1 + 100i_2 + 20i_2 = -80 \end{cases}$$

$$180i_1 - 100i_1 - 120i_2 + 120i_2 = 240 - 80$$

$$80i_1 = 160$$

$$i_1 = 2 \text{ A}$$

Substituindo em malha 1:

$$15 \cdot 2 - 10i_2 = 20$$

$$30 - 10i_2 = 20$$

$$-10i_2 = -10$$

$$i_2 = 1 \text{ A}$$

$$i_3 = i_1 - i_2$$

$$i_3 = 2 - 1$$

$$i_3 = 1 \text{ A}$$

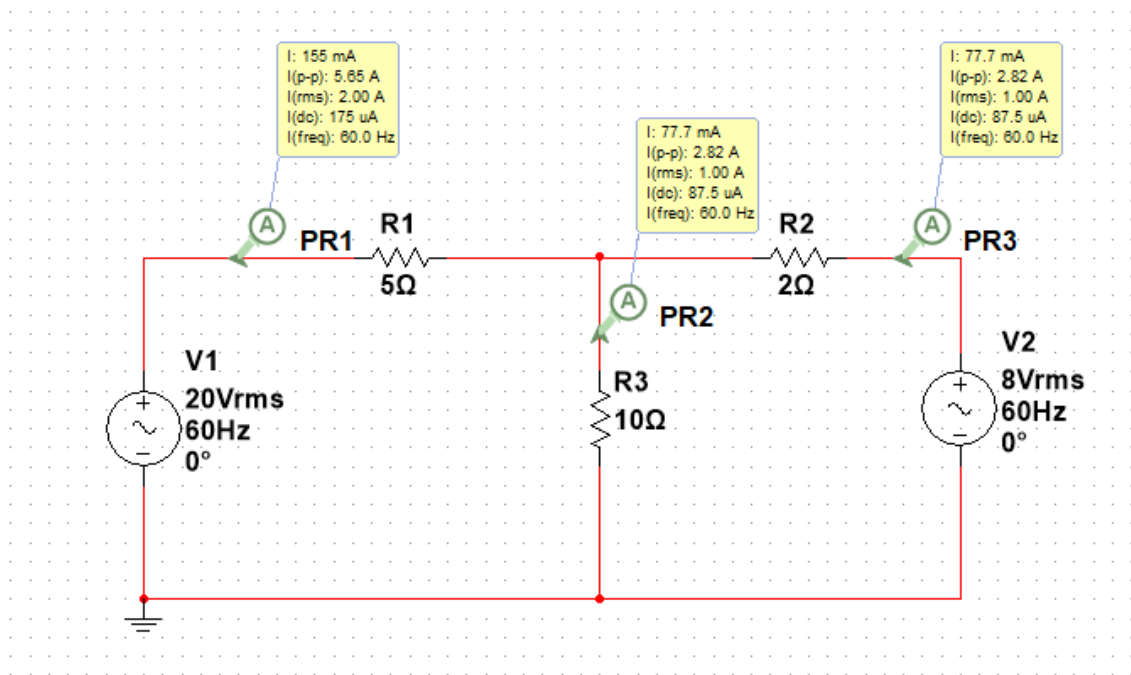


Figura 11 - Mensuração no circuito 3.1.4

TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
I1	2 A	2 A
I2	1 A	1 A
I3	1 A	1 A

3.1.5 - SUPERPOSIÇÃO

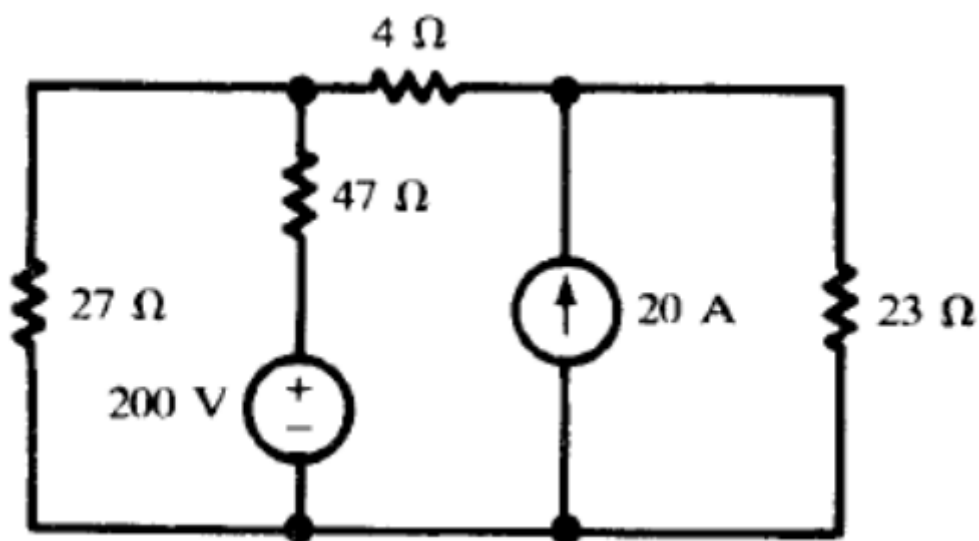
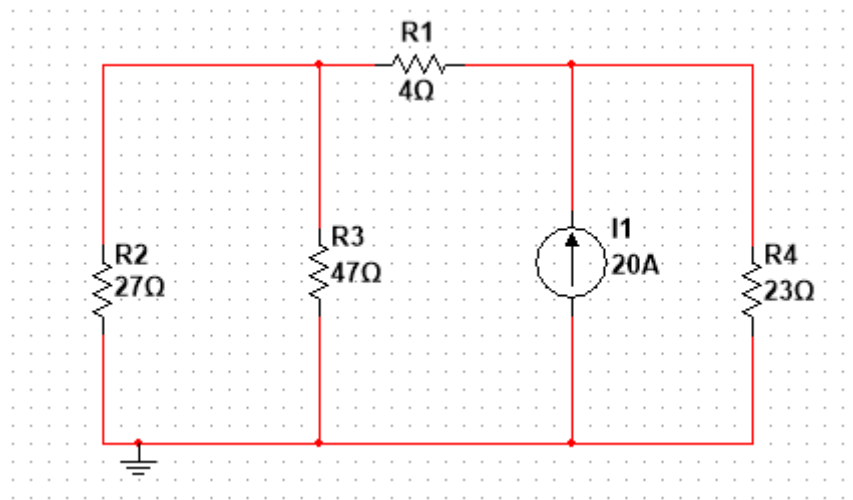


Figura 12 - Circuito 3.1.5 proposto

CÁLCULOS

V1 inativo e V2 ativo:



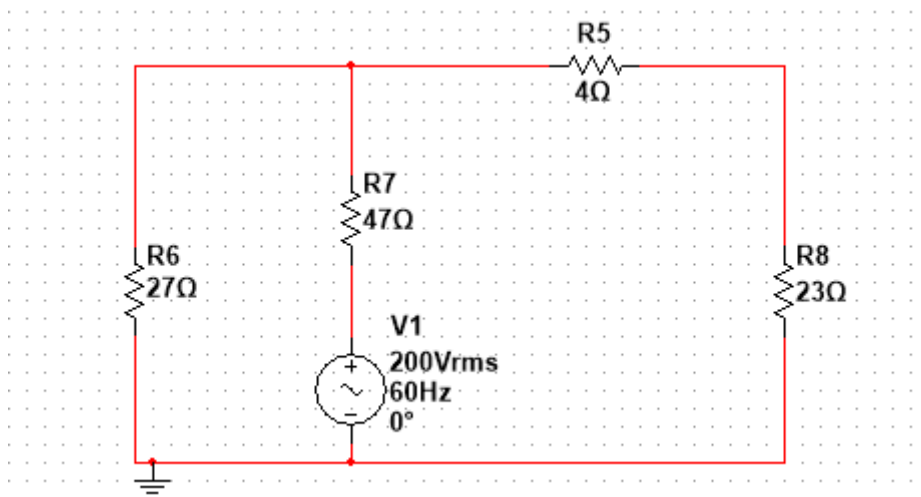
$$R_{eq} = (27 \parallel 47) + 4 = \frac{27 \cdot 47}{27 + 47} + 4 = 21,15 \, \Omega$$

$$R_{eq} = (21,15 \parallel 23) = \frac{21,15 \cdot 23}{21,15 + 23} = 11,02 \, \Omega$$

$$I_x = \frac{20 \cdot 23}{44,15} = -10,42 \, A$$

$$V_1 = 4 \cdot (-10,42) = -41,68 \, V$$

V1 ativo V2 inativo:



$$R_{eq} = (27 \parallel 27) + 47 = \frac{27 \cdot 27}{27 + 27} + 47 = 13,5 + 47 = 60,5 \, \Omega$$

$$I = \frac{200}{60,5} = 3,31 \, A$$

$$I_x = \frac{27 \cdot 3,31}{27 + 27} = \frac{89,37}{54} = 1,65 \, A$$

$$V_2 = 4 \cdot 1,65 = 6,62$$

$$V_x = 6,62 + (-41,68) = -35,06 \text{ V}$$

$$V_x = 35,06 \text{ V}$$

3.1.6 - THÉVENIN E NORTON

Calcule o equivalente de Thévenin e o equivalente de Norton para o circuito a seguir:

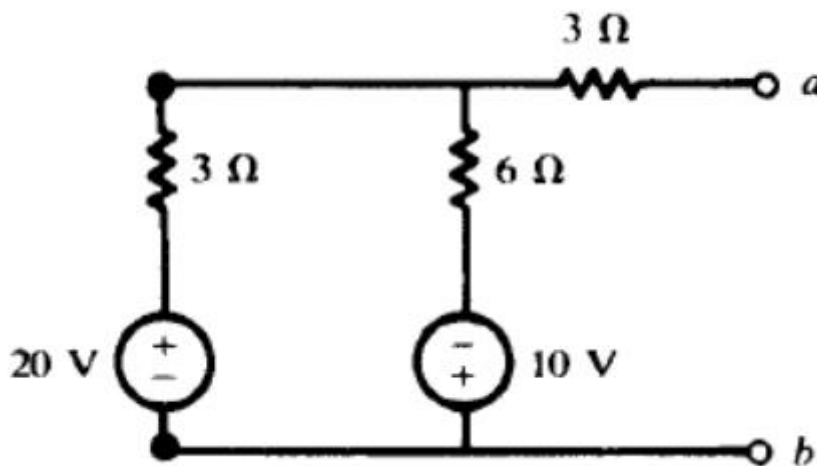


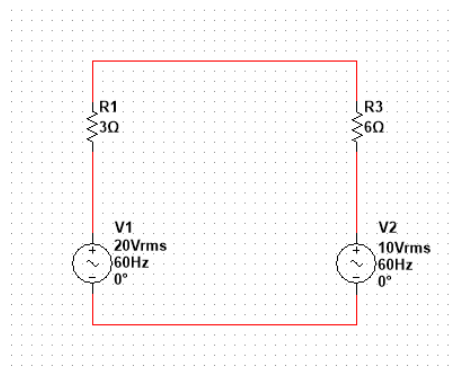
Figura 13 - Circuito 3.1.6 proposto

CÁLCULOS

Thévenin:

$$R_{th} = 6 \parallel 3 = \frac{6 \cdot 3}{9} = 2 \Omega$$

$$R_{th} = 2 + 3 = 5 \Omega$$



$$3i + 6i - 10 \text{ V} - 20 \text{ V} = 0$$

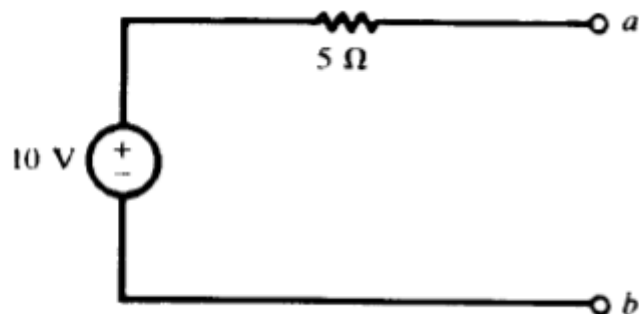
$$9i = 30 \text{ V}$$

$$I = 3,33 \text{ A}$$

$$V_{th} = R_3 \cdot I + V_2$$

$$V_{th} = 6 \cdot 3,33 - 10$$

$$V_{th} = 9,98 \text{ V}$$



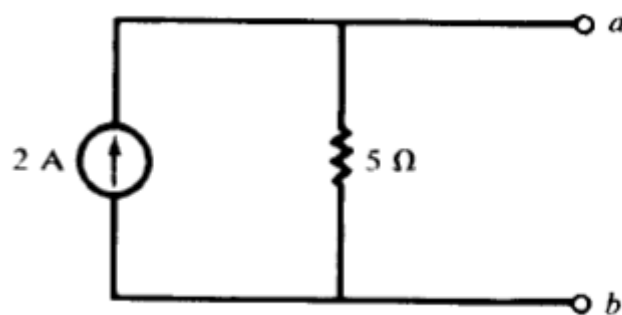
Norton:

$$R_{th} = R_n$$

$$R_n = 5 \Omega$$

$$I_n = \frac{V_{th}}{R_{th}} = \frac{9,98}{5}$$

$$I_n = 2 \text{ A}$$



(b) Norton Equivalent

3.2 – DIODOS

3.2.1 – DIODO IDEAL

Calcule I_D , I_R , V_D e V_R , para $E = 11\text{V}$. Considere o diodo ideal.

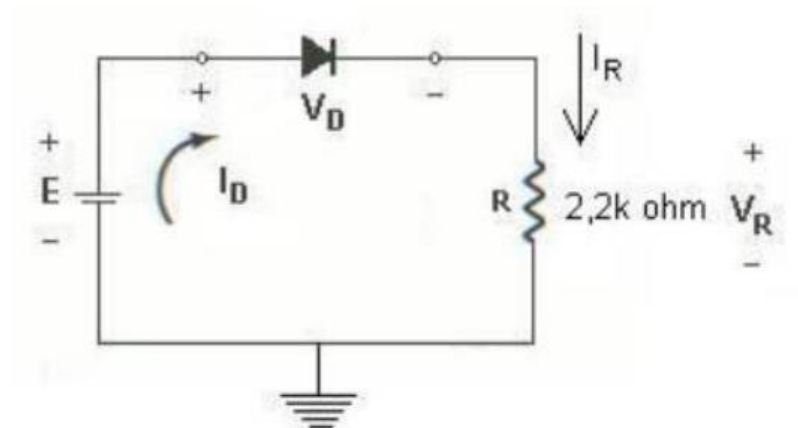


Figura 14 - Circuito 3.2.1 proposto

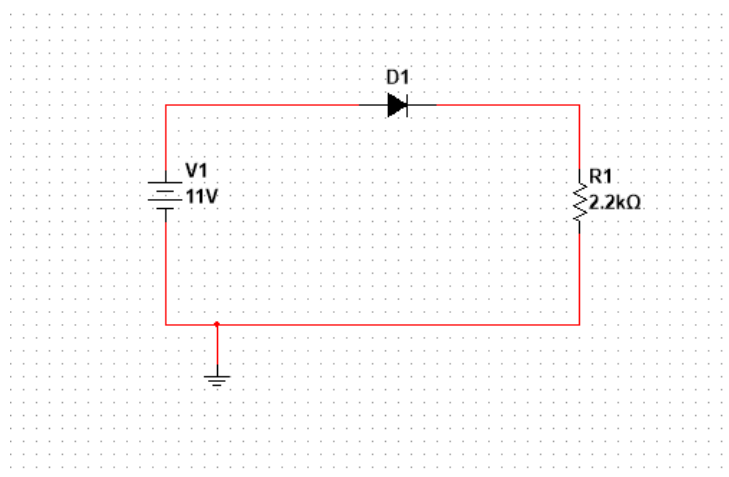


Figura 15 - Circuito 3.2.1 simulado

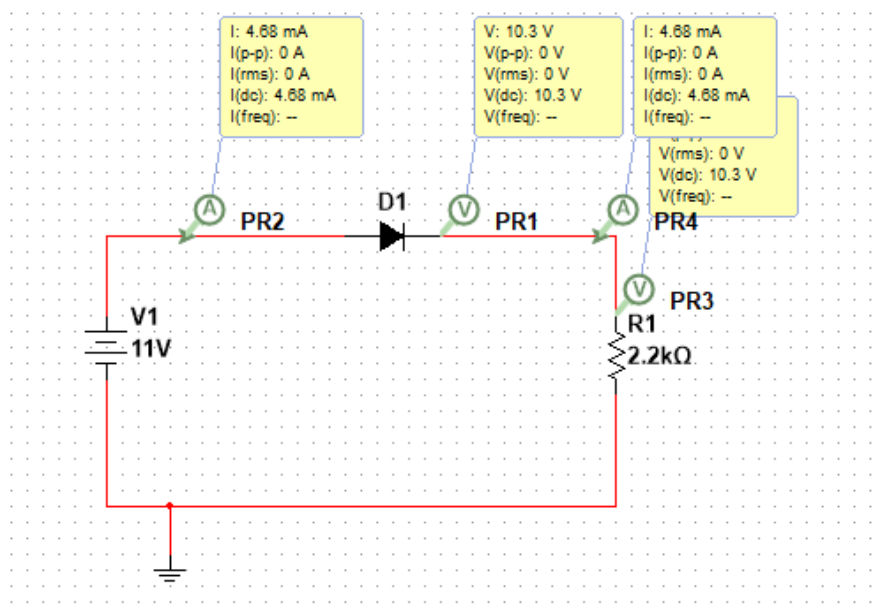


Figura 16 - Mensuração circuito 3.2.1

TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
ID	4,68 mA	5 mA
IR	4,68 mA	5 mA
VD	10,3 V	10 V
VR	10,3 V	10 V

CÁLCULOS

$$E - v_D - i * R = 0$$
$$E = V_d + i * R$$
$$I = \frac{11V}{2,2k\Omega} = 0,005 = 5\text{ mA}$$
$$11 = V_D + 0,005 * 2,2k$$
$$V_D = 11 - 0,005 * 2,2k$$
$$V_D = 11 - 1,1$$
$$V_D = 9,9\text{ V}$$
$$V_D = V_R$$
$$V_R = 10\text{ V}$$

Repita o exercício anterior considerando que a polaridade da fonte E foi invertida.

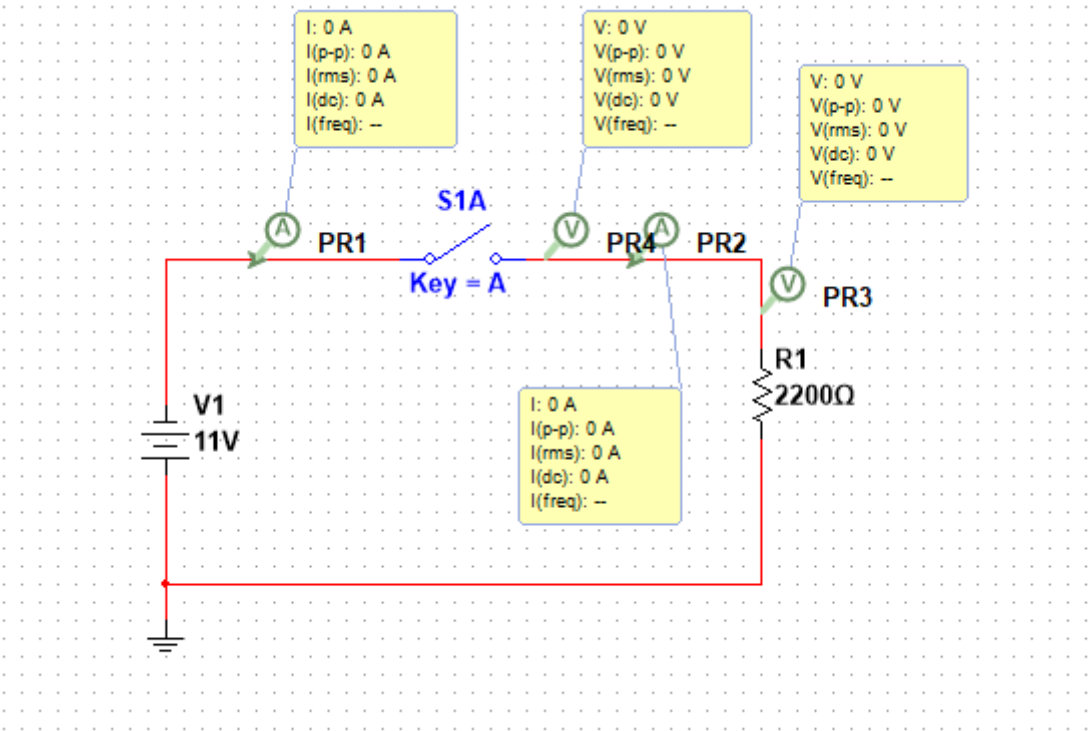


Figura 17 - Circuito 3.2.1 com a fonte invertida polarmente

3.2.2 – DIODO IDEAL

Calcule I_D , V_o e V_{D2} . Considere diodo ideal.

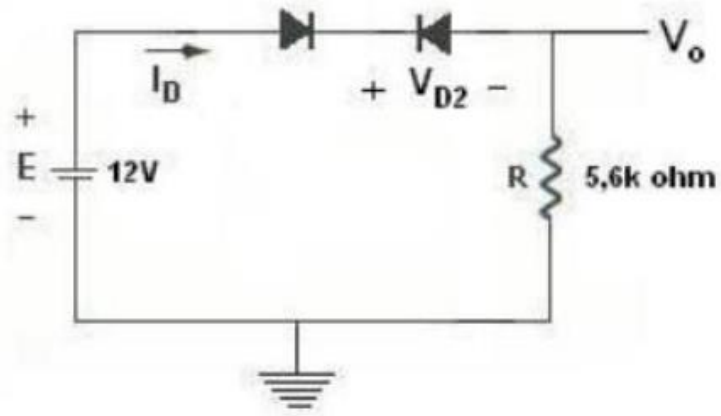


Figura 18 - Circuito 3.2.2 proposto

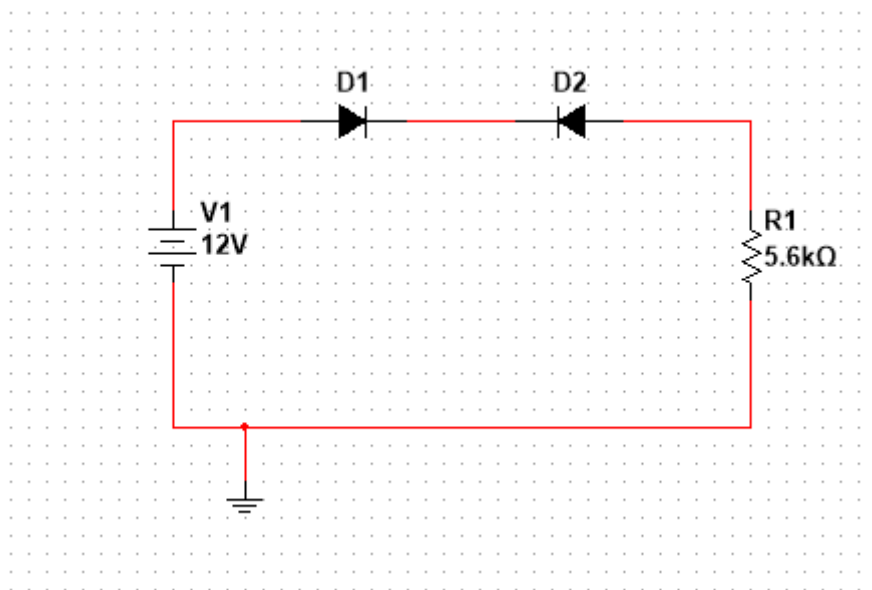


Figura 19 - Circuito 3.2.2 simulado

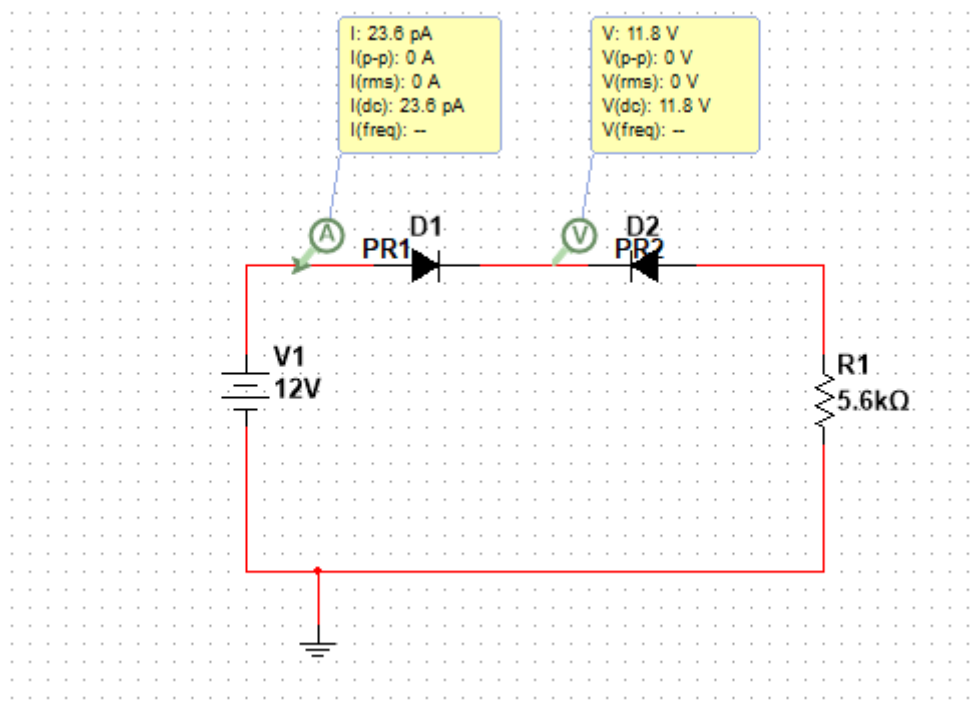


Figura 20 - Circuito 3.2.2 medido

CÁLCULOS

$$I_d = \frac{12}{5,6k}$$

$$I_d = 0,002143 \text{ A} = 0,214 \text{ mA}$$

$$V_0 = 0$$

$$V_{d2} = 12V$$

TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
ID	0,0023 A	0,0021 A
V0	0	0
VD2	11,8 V	12 V

3.2.3 – DIODO IDEAL

Calcule I, VA, VR e Vo. Considere diodo ideal.

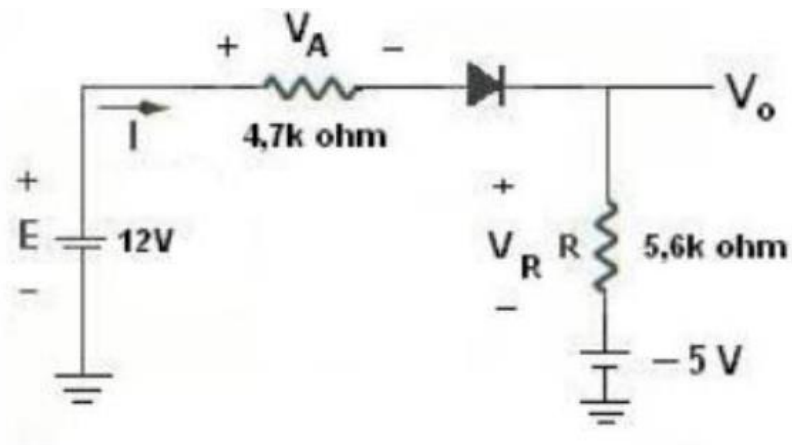


Figura 21 - Circuito 3.2.3 proposto

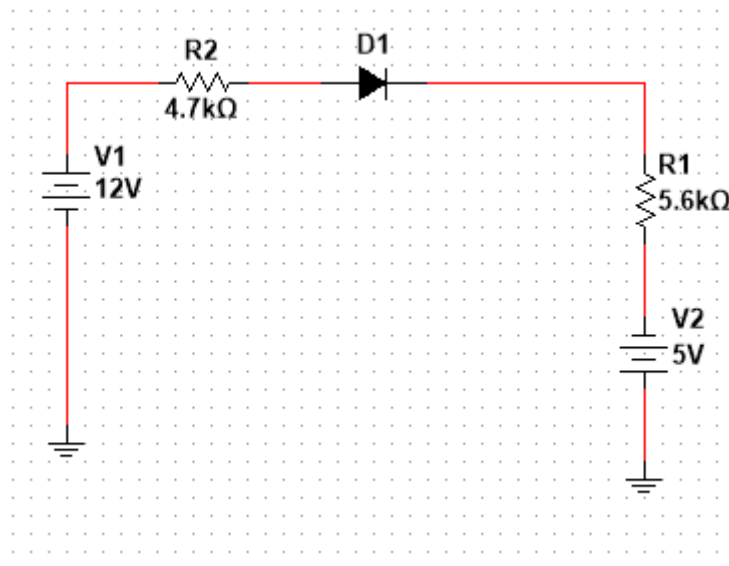


Figura 22 - Circuito 3.2.3 simulado

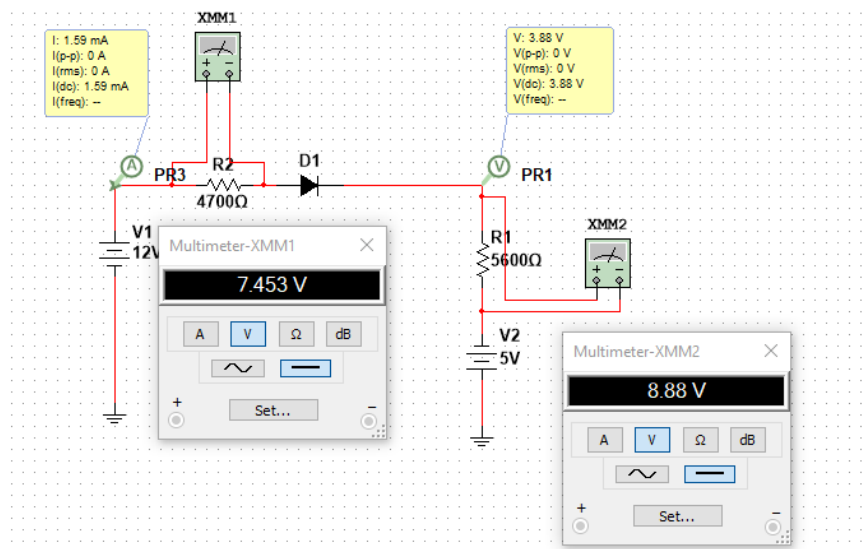


Figura 23 - Circuito 3.2.3 medurado

CÁLCULOS

$$I = \frac{12 + 5}{4,7\,k + 5,6\,k} = \frac{17}{10,3k} = 0,0016A = 1,6\,mA$$

$$VA = R * i = 4,7k * 0,0016 = 7,52\,V$$

$$VR = 5,6\,K * 0,0016 = 8,96\,V$$

$$v_0 = 10,3k * 0,0016 = 16,48\,V$$

TABELA COMPARATIVA

PARÂMETRO	SIMULADO	TEÓRICO
I	1,59 mA	1,6 mA
VA	7,453 V	7,52 V
VR	8,8 V	8,96 V
V0		

3.2.4 – FORMA DE ONDA

Obtenha a forma de onda v_0 para a entrada mostrada. Considere diodo ideal

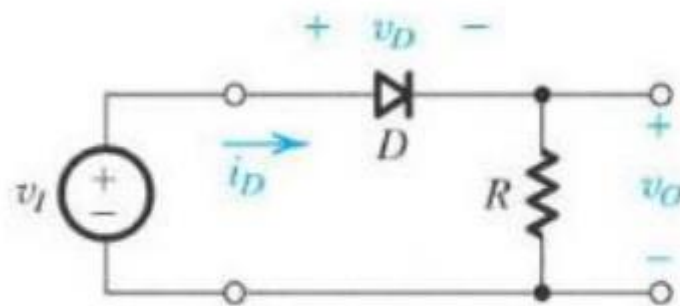


Figura 24 - Circuito 3.2.4 proposto

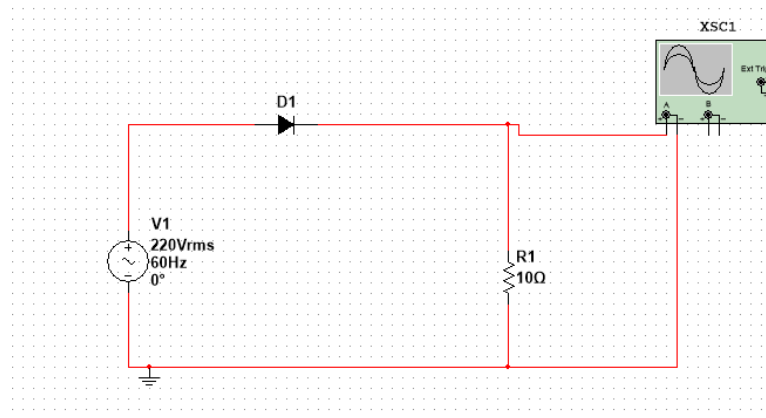


Figura 25 - Circuito 3.2.4 simulado

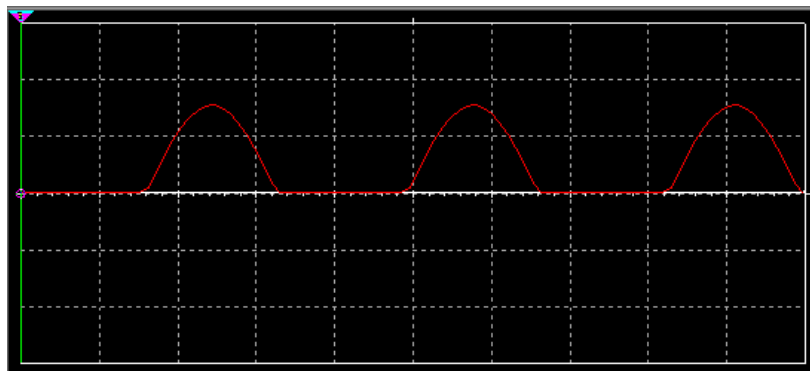


Figura 26 - Circuito 3.2.4 forma de onda

3.2.5 – FORMA DE ONDA CHAVE ABERTA E FECHADA

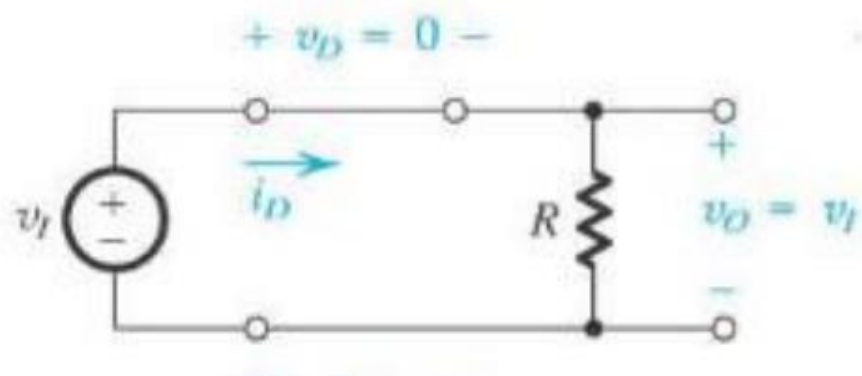


Figura 27 - Circuito 3.2.5-1 proposto

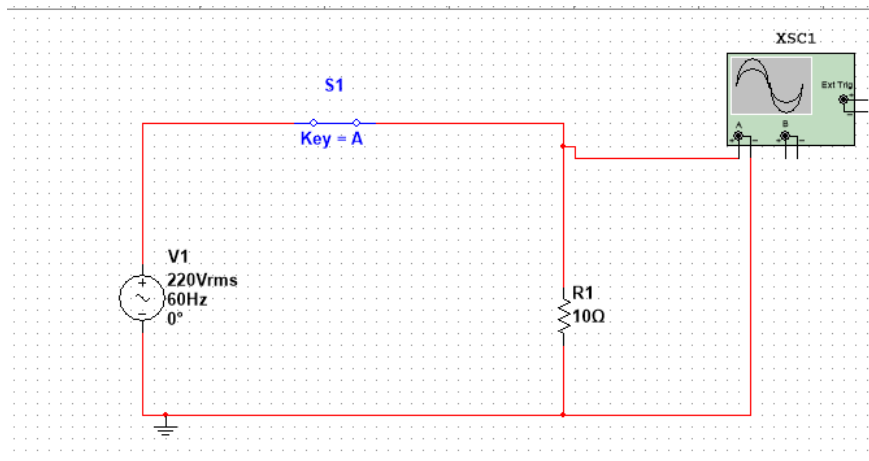


Figura 28 - Circuito 3.2.5 -1 simulado

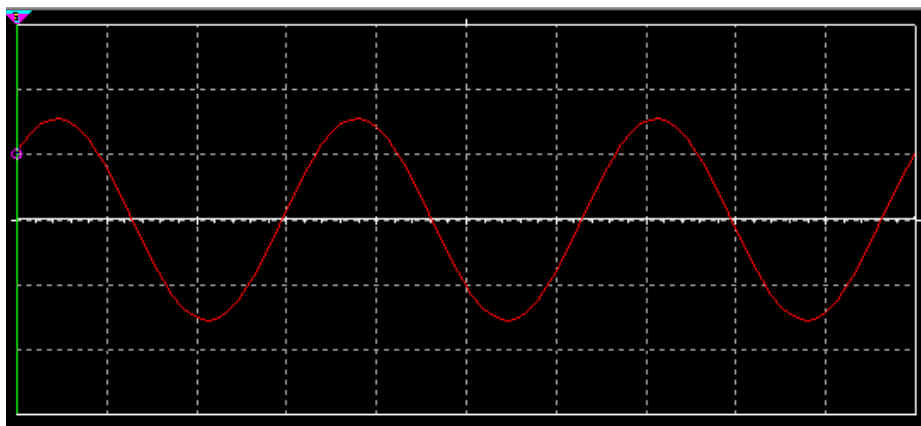


Figura 29 - Circuito 3.2.5-1 forma de onda

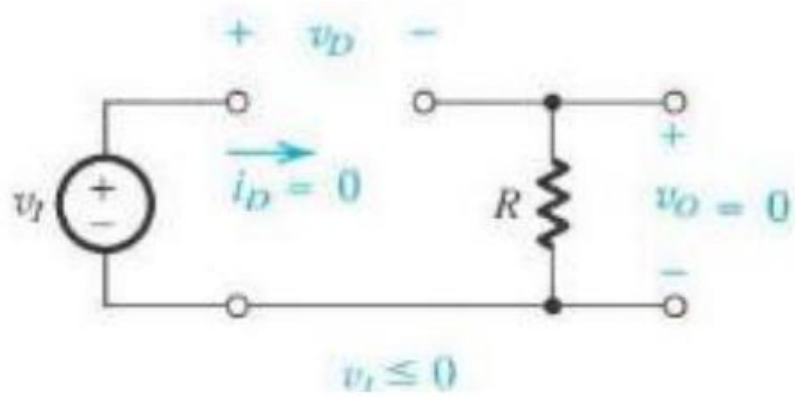


Figura 30 - Circuito 3.2.5-2

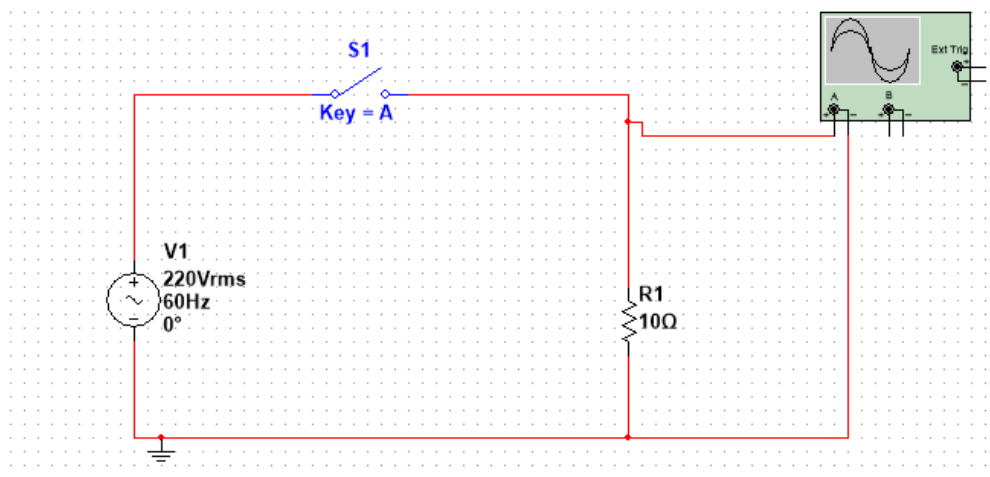


Figura 31 - Circuito 3.2.5 - 2 simulado

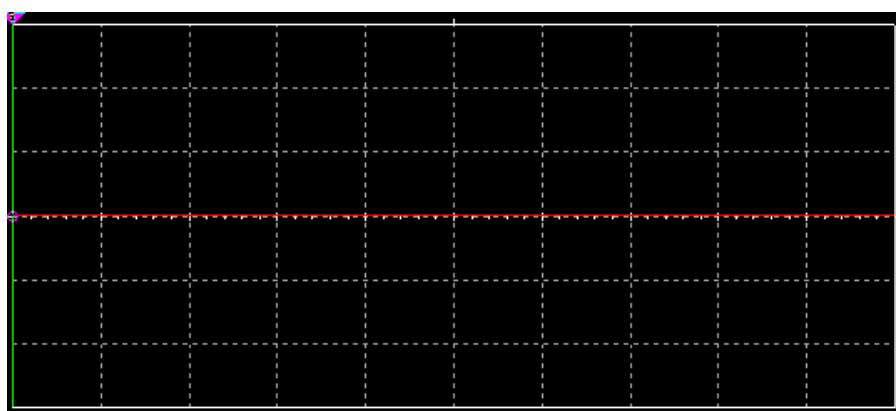


Figura 32 - Circuito 3.2.5-2 forma de onda

3.2.6 – DC SWEEP

Gerar a curva de um ou mais diodos utilizando a ferramenta DC Sweep do software Multisim.

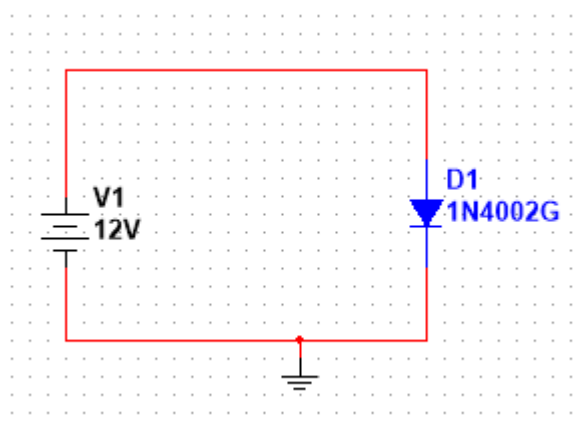


Figura 33 - Diodo número 1

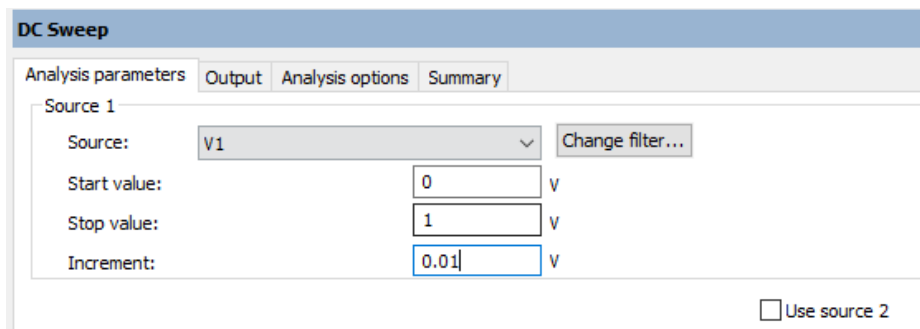


Figura 34 - Configurações DC Sweep

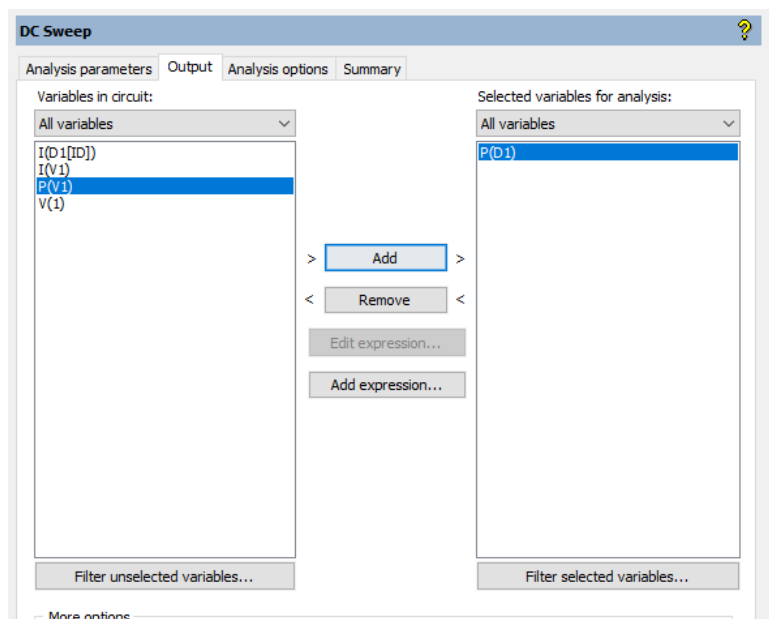


Figura 35 - Configurações de saída DC Sweep

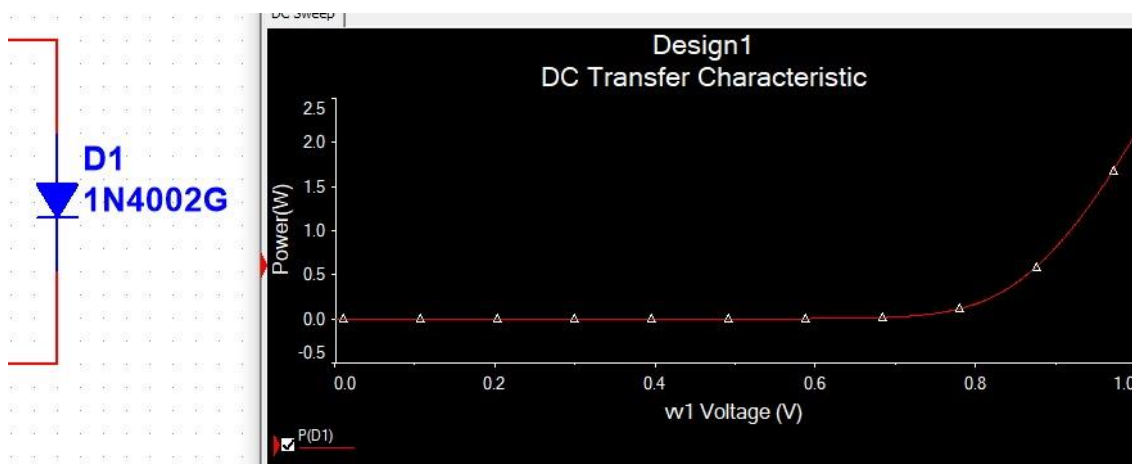


Figura 36 - Curva do diodo 1N4002G

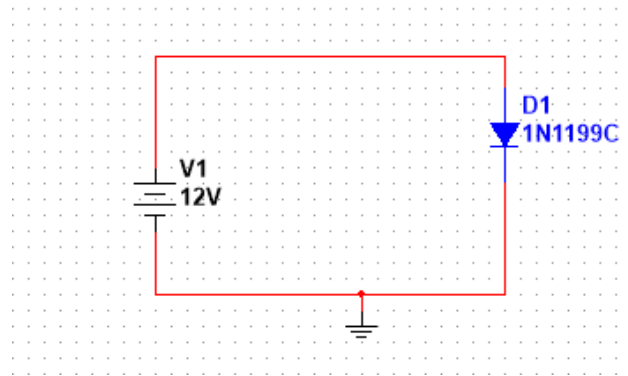


Figura 37 - Diodo número 2

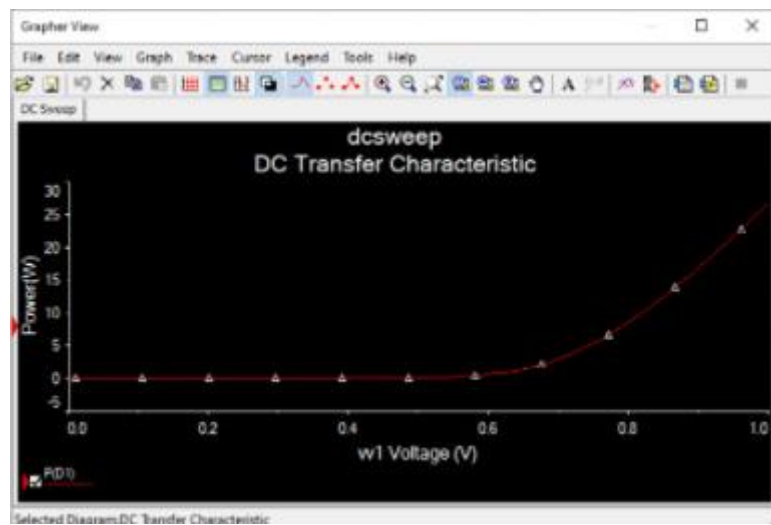


Figura 38 - Curva do diodo 1N1199C